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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/845,526	04/25/97	PAPAKIPOS M	SGI-15-4-453

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EXAMINER	
PADMANABHAN, M	
ART UNIT	**PAPER NUMBER**
2772	13

DATE MAILED: 08/01/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. 08/845,526	Applicant(s) Papakipos et al.
	Examiner Mano Padmanabhan	Group Art Unit 2772

☒ Responsive to communication(s) filed on *Jun 23, 2000*.

☒ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) *1, 2, 6-9, 12-16, and 18-25* is/are pending in the application.

Of the above, claim(s) ______ is/are withdrawn from consideration.

☐ Claim(s) ______ is/are allowed.

☒ Claim(s) *1, 2, 6-9, 12-16, and 18-25* is/are rejected.

☐ Claim(s) ______ is/are objected to.

☐ Claims ______ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on ______ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on ______ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) ______.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ______.

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). ______

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- ***SEE OFFICE ACTION ON THE FOLLOWING PAGES*** ---

DETAILED ACTION

Applicants response and amendments received at the office on 6/23/2000 in response to the office action mailed on 1/18/2000 have been fully considered. The 103 rejections made in the previous action are maintained for claims 1-2, 6-9, 12-16, and 18-25.

Status of claims

Claims 1-2, 6-9, 12-16, and 18-25 are in the Application.

Claims 3, 4, 5, 10, 11, and 17 have been canceled.

Claims 1, 2, 6-9, 12-16, and 18-25 are rejected.

Claim Objections

The amendment has overcome this objection.

Claim Rejections - 35 USC § 112

The amendment has overcome this rejection.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 1-2, 6, 8, 13, 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847).

In claim 1, the applicant lays claim to a computer system that implements the method of receiving a NURBS model from a server, converting it to a Bezier model, genérate a plurality of control points on the Bezier curve from a plurality of NURBS control points using a tri-linear interpolator in the graphics pipeline, using NURBS control points as input to the tri-linear interpolator, and evaluating these points to generate Bezier control points and rendering the curve using the graphics pipeline, **without first converting the NURBS defined curve or surface to a polygon mesh.**

Jia et al teach a method of converting a NURBS surface model to a Bezier surface model, evaluating a plurality of NURBS control points into Bezier control points (Col.3: lines 32-37, Col. 4: lines 38-45), and interpolating a plurality of control points (Col. 5: lines 1-5). **Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh (Fig.5).** *Jia et al* fail to teach the use of tri-linear interpolator, and a method to receive the data from the server (host processor) and rendering it. *Gharachorloo et al* teach a method to receive data from a host processor into a graphics pipeline, and use the graphics pipeline to render the object (refer Figs. 1, 2, 2A). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between

the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it would be obvious to one skilled in the art at the time the invention was made to store the surface model data in a host processor, and use this method to download the data as needed, and use a tri-linear interpolator to generate the Bezier control points from NURBS control points as this would ensure better utilization of system processing resources on the client, and provide high speed and accuracy and enable velocity control to a given tolerance.

Claim 2 adds to claim 1 the step of receiving the NURBS surface model via the bus.

Gharachorloo et al teach a method to receive data using a bus (refer Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention was made to use a bus to receive the NURBS model from a host processor, as it is an effective and dependable communication medium.

Claim 6 adds to claim 1 the limitation of generating points on the curve using Bezier control points.

Jia et al disclose the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44).

Claim 8 adds to claim 1 the use of graphics rendering pipeline to render the curve or surface.

Gharachorloo teaches the use of a Graphics pipeline (Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the curve as this would streamline the process, and accelerate the process of rendering the curve.

Claim 13 lays claim to a graphics rendering pipeline of a computer system that evaluates the NURBS control points to a Bezier model using a tri-linear interpolator in the graphics pipeline, generates a plurality of control points on the Bezier curve, and renders the curve.

Jia et al teach a method of loading a processor with the NURBS control points (Col.3: lines 32-36), converting the NURBS surface model to a Bezier surface model (Col. 4: lines 38-48), and determining a plurality of points on the Bezier curve. *Jia et al* fail to teach a method of rendering the curve using a graphics pipeline. *Gharachorloo et al* teach a method of using the graphics pipeline to render NURBS surfaces (Col.9: lines 64-67). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the Bezier curve using the points derived by using the method as

described by Jia, as this would streamline the rendering process, and ensure better utilization of system processing resources, and provide better control over velocity levels.

Claim 14 adds to claim 13 the limitation of using a tri-linear interpolator to evaluate the NURBS control points into Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier control points. Jia fails to teach the use of tri-linear interpolator, and the input of NURBS control points to the tri-linear interpolator. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Hence it is obvious to one skilled in the art at the time the invention was made to use a tri-linear interpolator to generate the Bezier control points since this will provide high speed and accuracy.

Claim 15 adds to claim 13 the step of transforming the NURBS curve or surface from a global domain to a local domain.

Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27). Hence it is obvious to one skilled in the art at the time the invention was made to use global to local

transformation of the NURBS curve, as such a transformation can make better utilization of the available resources.

6. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847) as applied to claim 6, and further in view of Sherman et al. (U.S. Patent 5,734,756).

Claim 7 adds to claim 6 the limitation that the Bezier control points are input to a tri-linear interpolator to generate points on the curve.

Jia et al disclose the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44). Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Jia et al fail to disclose the use of tri-linear interpolator. Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Sherman et al teach that Bezier curves are generally evaluated using a recursive algorithm due to de Casteljau (Col.14: lines 32-35). Since Bezier curve is a special case of a NURBS curve, it would be obvious to one skilled in the art at the time the invention was made to input the Bezier control points to a tri-linear interpolator to generate points on the curve, as this would improve system performance.

7. Claims 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Luken, Jr.* (U.S. Patent Number 5,278,948), *in view of Jia et al.* (U.S. Patent Number 5,726,896), *Sherman et al* (U.S. Patent Number 5,734,756), and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 9 lays claim to a method of rendering curves by evaluating a Bezier curve using de Casteljau process using a tri-linear interpolator in the graphics rendering pipeline, without first converting the NURBS defined curve or surface to a polygon mesh.

Luken teaches the use of Cox-DeBoor (or DeCasteljau) process for evaluating a b-spline curve (Col.15: lines 40-44). Luken also teaches the method of using a graphics pipeline (Col.28: lines 59-61), and the use of Cox-DeBoor process in the graphics processor for evaluation (Col.29: lines 5-10). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to teach the use of these methods for a Bezier curve. Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman discloses that the de Casteljau process is a widely accepted method of evaluating Bezier curves (Col. 14: lines 32-35). **Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh (Fig.5).** Hence it would be obvious to one skilled in the art at the time the invention was made to use the de Casteljau process, and a tri-linear interpolator in the graphics pipeline to evaluate and render a Bezier curve, since this would render the system faster.

4. Claims 16, 18, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,278,948) as applied to claim 16, in view of *Jia et al.* (U.S. Patent Number 5,726,896) and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 16 lays claim to a method of generating normal vectors for a surface based on generating surface partials using a tri-linear interpolator loaded with Bezier control points as input, then generating surface tangents from these partials, and generating normals from these tangents.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken also teaches the use of interpolators for each component to derive the surface partials (Col. 19: lines 18-25). Luken fails to teach the use of Bezier control points as input to the tri-linear interpolator. Jia teaches the method of evaluating Bezier control points (line 35-40). Jia also teaches that Bezier curve is a special case of a B-spline curve. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it is obvious to one skilled in the art at the time the invention was made to use Bezier control points as input to a tri-linear interpolator to generate surface partials, since Bezier points are a subset of NURBS control points.

Claim 18 adds to claim 16 the step of generating the surface tangents from the surface partials using a blender in the graphics pipeline.

Luken teaches the generation of surface tangents from surface partials for NURBS surfaces (Col.9: lines 6-25). Luken fails to teach this for blending curves. Jia teaches that the Bezier curves are a special case of B-splines, and also teaches the use of Bezier curves as blending functions (Col. 7: lines 29-31). Hence it is obvious to one skilled in the art at the time the invention was made to use such blending curves, since the shape approximation with NURBS is not generally understood, and the NURBS can be exactly represented by a series of piecewise Bezier curves.

Claim 19 adds to claim 18 the step of generating at least one normal from the surface tangents.

Luken teaches the method of generating normals from surface tangents ((Col.9: lines 6-25).

8. Claims 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Claim 20 lays claim to a method of rendering a curve by doing a global to local transformation, evaluating the NURBS control points using tri-linear interpolation, and rendering the curve using the points thus created.

Luken teaches a method of evaluating NURBS control points to derive points on the curve (Col.15: lines 40-45). Luken inherently teaches the use of tri-linear interpolators by

disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to teach a transformation from global domain to local domain. Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27), rendering a NURBS curve. Hence it would be obvious to one skilled in the art at the time the invention was made to use the transformation as taught by Gharachorloo so as to make better utilization of the local resources.

Claim 21 adds to claim 20 the step of indexing at least one look up table for performing the transformation.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics control processor (Col.12: lines 18-20).

Claim 22 adds to claim 21 the limitation of evaluating the NURBS control points using tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators for evaluating the NURBS control points, by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45).

Claim 23 adds to claim 22 the limitation of indexing the look up table to be able to configure the tri-linear interpolator.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics control processor (Col.12: lines 15-20), which is used to transform the x, y, z coordinates of the control points.

Claim 24 adds to claim 23 the step of implementing a quadri-linear interpolator using tri-linear interpolator, and generating control points.

Luken discloses the existence of NURBS control points with coordinates (wx,wy,wz,w), and the evaluation of such control points by interpolation (Col.15: lines 32-46). This inherently teaches quadri-linear interpolation.

9. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), and further in view of Oha (U.S. Patent Number 5,202,670).

Claim 25 adds to claim 20 the use of convolution in the graphics pipeline to obtain points on the curve.

Oha teaches the convolution of original data and interpolated function in the graphics pipeline to derive a set of points on the curve (Col.15: lines 5-13). Hence it is obvious to one skilled in the art at the time the invention was made to use convolution in order to achieve faster processing of the control points.

Response to Arguments

10 Applicant's arguments filed on 12/10/99 have been fully considered but they are not persuasive. Applicants argue that Jia is concerned with spline interpolation for the control of numerically controlled machines. It is being reiterated that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). Jia teaches the art of converting an inputted NURBS surface model to a Bezier surface model, evaluating a plurality of NURBS control points into Bezier control points (Col.3: lines 32-37, Col. 4: lines 38-45), and interpolating a plurality of control points (Col. 5: lines 1-5). While Jia uses the Bezier surface model in the control of a CNC machine, to control the machine tool to a defined path, there is nothing in Jia that precludes one from displaying the curve or surface thus generated, and using Jia's teaching in other applicable situations.

As to applicant's argument that Jia describes Fig.5 as showing the cubic curve in Fig.2, by its Bezier control polygons, it is noted that Jia teaches that the "coefficients of the control polygons define five different Bezier curves", and hence do not constitute a polygon mesh for the inputted NURBS model.

As per Luken, Luken teaches determining the x, y, and z components of a NURBS surface by evaluating a polynomial function of the parametric coordinates for x, y, and z (Col.4).

Luken also teaches performing linear interpolation between the components of the control points, the three (x, y, and z) components giving rise to tri-linear interpolations.

With respect to combination of references, Luken lists a number of advantages of evaluating and rendering surfaces based on NURBS, including cost effectiveness, high speed, and accuracy, and good numerical stability, elimination of data redundancy, avoidance of artifacts, construct complex surfaces using low order NURBS, local control, etc. (Cols.2 & 3). Jia teaches interpolating NURBS to maintain a controlled velocity (numerical control), and providing accurate acceleration and deceleration, and significantly reduce the amount of data required in the process (Abstract). Since Luken provides the advantages sought by Jia, it would have been obvious to use Luken's tri-linear interpolation with Jia, and Gharachorloo, and Schulmeiss to render a NURBS model as claimed.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

Any response to this correspondence should be mailed to:

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or faxed to:

(703) 305-9051, (for formal communications; please mark "EXPEDITED PROCEDURE")

Or:

(703) 308-6606 (for informal or draft communications, please label "PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal Drive, Arlington. VA., Sixth Floor (Receptionist).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mano Padmanabhan whose telephone number is (703) 306-2903. She can normally be reached Monday-Thursday from 6:30am-5:00pm.

If attempts to reach the examiner are unsuccessful, the examiner's supervisor, Mark Zimmerman, can be reached on (703) 305-9798.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

MP

Mano Padmanabhan

July 25, 2000

Mark Zimmerman

MARK ZIMMERMAN
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